DOCUMENT RESUME

ED 276 978 CS 008 618

AUTHOR Tomlinson, Louise M.
TITLE Overview of Computer Applications in Reading.
PUB DATE [80]
NOTE 46p.
PUB TYPE Information Analyses (070)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; *Computer Managed Instruction; Computer Oriented Programs; Computer Software Reviews; *Computer Uses in Education; Educational Television; Elementary Secondary Education; Literature Reviews; *Reading Instruction; *Reading Processes; Reading Research; Teacher Education

ABSTRACT

Reviewing computer applications in reading and reading instruction, this article covers the following topics: the emergence of computer instruction from teaching with television, the variety of input and output devices, types of interaction between user and program, methods and approaches, degrees of generalization, scope and capacity of programs, and adaptability to and acceptance by various populations. Relevant literature is examined from the following perspectives: (1) understanding of the reading process through computers, (2) training of reading teachers through computers, (3) the use of computers in reading instruction--computer aided instruction, computer managed instruction, and the role of the programer. Some of the hardware and software mentioned include: CARIS (Computer Animated Reading Instruction), IBM 1500 (designed specifically for instructional purposes), HP2000F (computer), Commodore PET Computer, TRS-80 Voice Synthesizer, Sol-20 Computer, Lite I (Initial Reading and Job Orientation Program), and Lite II (Career Oriented Reading in Various Job Areas), Simuread Program, and PLATO. It is urged that computers be regarded as a valuable aid to teachers in providing quality education and researching reading behavior. Conclusions speculate on why computers are not utilized more fully in reading research and instruction given their abounding capabilities and exiting applications to the field. (Author/JD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ED276978

Overview of Computer Applications in Reading

Louise M. Tomlinson

University of Wisconsin-Madison

Department of Curriculum and Instruction-Reading

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Louise M. Tomlinson

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Running head: Overview of Computer Applications in Reading

CS008618

Abstract

Computer applications in reading processes and reading instruction are reviewed. Topics include: the emergence of computer instruction from teaching with television, the variety of input and output devices, types of interaction between user and program, methods and approaches, degrees of generalization, flexibility of programs, preciseness of presentation, scope and capacity of programs, adaptability to and acceptance by various populations. The relevant literature is examined from the following perspectives: Understanding of the Reading Process Through Computers, Preparation of Reading Teachers (Pre-Service) Through Computers, The Use of Computers in Reading Instruction--CAI and CMI, and The Role of the Programmer. It is urged that computers be regarded as an aid to the teacher in providing quality education for all--including the gifted and handicapped, and also as a valuable instrument in researching reading behaviors.

Overview of Computer Applications in Reading

In order to fully appreciate the advent of computer application to reading and reading instruction we should first acknowledge its emergence from the practice of teaching with television. Mason and Mize (1978) report that, by 1975, at least 95% of American households had at least one television set and the average sixth grader watched three to six hours of television per day. It has also been indicated that a school age child was likely to spend more time watching television than indulging in any other activity except sleep. This devotion caused educators and parents to become concerned about the content of T.V. programs and their effects.

The recognition of T.V. as a medium of phenomenal interest to children has given way to many efforts to teach reading through televised instruction. Mason and Mize cite several instances in which such instruction has been provided in a variety of settings and methods: during a school strike in Baltimore, several thousand children were presented T.V. lessons, from which it was reported that the children claimed to have learned best from the lessons in science and language arts; in a study conducted in 1967, and said to foreshadow the use of the computer to teach reading, a phonic word reading project was

administered, in Albuquerque, New Mexico, to children aged two to four, by means of a light sensitive cathode ray tube (when words and pictures were displayed on the screen, accompanied by audio directions, the children responded by pointing a light pencil to the appropriate part of the screen); in a study conducted in 1971 over closed circuit T.V. to seventh and eighth graders in Phoenix, it was concluded that written reinforcement helps students make greater gains in learning vocabulary taught by instructional T.V.; in another study in 1976 printed sentences were displayed on a television screen with each syllable timed to appear exactly when it was spoken--from this they found that sentences presented with "visual rhythm" were read more fluently; Bretz (1969) found that the Chicago Schools use of T.V. as a means of instruction in ghetto schools resulted in significant improvement of attitude and academic achievement; when Perlish (1968a, 1970) taught pre-reading and reading skills with a half-hour television show five days per week for 39 weeks, the 70 members of the experimental group earned significantly higher scores on a criterion reading test than the 80 members of the control group; and, finally, when Dunn (1970) used closed circuit T.V. to present the alphabet, letter sounds, and basic vocabulary to 90 two to four year olds, he found that the greatest gains were made by

children from low SES, and that age and verbal intelligence were not related to the gains achieved--these gains were positively related to the amount of time spent by parents in follow-up activities with their children.

Although the first computer based reading program was underway by 1964 in Palo Alto, California, under the direction of Stanford and IBM, televised instruction has continued to serve as an indicator and inspiration to the use of computerized reading programs. The merging of televised and computer-assisted instruction was achieved by the "Tele-Catch" system (Computer-Tutor, 1976), which was funded by the State of New York. It allowed children who could not attend school to dial a computer by telephone, in order to receive cable-transmitted television lessons, after placing their phone receivers into an acoustic coupler or modem which included a typewriter keyboard. Another T.V.-computer system, conducted in the San Francisco Bay Area of California, under the provision of Title I ESEA, in the mid-70s, involved the use of real time off air broadcasts retained on videocassette copies. In this situation, Eller (1975) found that the teachers involved in the pilot project preferred videocassette delivery to real time off air broadcasts because: the cassettes enabled the teacher to be flexible in scheduling use, the cassettes could be replayed as necessary--either

for a class or an individual student, and the cassettes could be partially used.

It should be noted, at this point, that these very same advantages of cassette use are inherent in computer access. In an examination of educational (public) television and reading, specifically the "Sesame Street" program, Mason and Mize cite Ball and Bogatz (1970) who reported that "the comparison of at-home viewers with at-school viewers was unsuccessful because so few at-home viewers watched with any consistency". It was also indicated that the gains of Spanish-speaking children were spectacular). The observation of inconsistency in at-home viewers, in spite of children's affinity for television, is in itself a prime indicator of the promise and advantage of computerized instruction--with the presence of the teacher to maintain consistency, while providing reinforcement and follow-up. According to Blanchard (1980), computers have been a part of our daily lives for years, but their role in today's reading classrooms is still largely not realized or understood, nor fully explored.

At about the same time as the Stanford project, PLATO was initiated at the University of Illinois, but reading research was not included in their ventures until the early 70s. At this point, their efforts have expanded throughout the U.S. and Canada and include programs for reading

readiness, initial reading skills and adult basic education. Aside from PLATO's offerings, there are now numerous other computer programs in reading available to facilitate the understanding of reading processes, preservice preparation of teachers in reading instruction, computer-assisted instruction (developmental, remedial, and speed), computer-managed instruction, and performance data collection for programmers who are continuously evaluating and revising programs.

With the wide array of computer applications to reading and reading instruction, there are also a great variety and range of in-put and out-put devices, types of interaction between user and program, methods and approaches (teaching styles), degrees of generalization, flexibility of presentations, preciseness of presentations, scope and capacity (resources) of programs, adaptability to various populations in various settings, and acceptance by various populations. It is unlikely that any two programs which propose to fulfill the same objectives will encompass all of these aspects in exactly the same fashion. In order to take into account the above mentioned considerations of computers and reading, it will be convenient to examine the literature from the following perspectives:

- Understanding of the Reading Process Through Computers
- Preparation (Pre-Service) of Reading Teachers Through Computers
- The Use of Computers in Reading Instruction
  a) CAI
  b) CMI and
- The Role of the Programmer

Some of the hardware and software enterprises which accommodate reading and reading instruction that will be mentioned in the following discussion include:

- CARIS (Computer Animated Reading Instruction)
- IBM 1500 (designed specifically for instructional purposes)
- Learning Management Program (developed by Learning Unlimited Corporation)
- HP2000F (computer)
- Commodore PET Computer
- TRS-80 Voice Synthesizer
- The Sol-20 Computer
- Lite I - Initial Reading and Job Orientation Program
- Lite II - Career Oriented Reading in Various Job Areas
- Simuread Program

and

- PLATO (which has been previously mentioned)

It is hoped that a look at these and other available

programs and devices, within the selected parameters (above), will enhance our knowledge of computer applications in reading and reading instruction, and provide us with a scope of measurements for future evaluation of such resources.

Understanding the Reading Process Through Computers

In accordance with a teaching methodology recognized as the linguistic approach, which evolved from the idea that a child should be taught the alphabetic principle by means of the printed equivalents of his/her oral vocabulary, the computer has been used to simulate the reading process by identifying the graphic and oral language determinants of segmental and suprasegmental phonemes in the reading product. In successful reading, this process of graphemephoneme association is also referred to as coding. Leton (1974) indicates that there are at least three separate and interrelated codes in orthography: alphabet, punctuation, and logograms. He identifies two codes in phonemics: segmental phonemes and suprasegmental phonemes. From this analysis, Leton concludes that the term coding does not refer to a single, simple process--not even for beginning reading. He considers oral and written representations of language to be hierarchical systems of codes. It is upon this basis that a computerized simulation of reading known as Simuread was constructed.

This simulation has been described as a double simulation problem. The orthography is simulated by holes in data cards and by patterns of electronic current in the computer. The holes are keyed to represent the letters of the alphabet and other logographs, and are then converted to on-off states of electrical currents--which is actually binary coding. Leton implies that there are similarities between the human reception of orthography and computer input, since the human eye and the keypunch can both be considered transducers--transferring orthography from the external environment and initiating the process of internal coding. The coding for the oral representation of language is simulated by the energy from the electric current in the internal environment of the computer to the printer and/or phonetic-acoustic code in the external environment. The printer is said to simulate oral language by printing predesignated numerical symbols from segmental phonemes. It is indicated that the printer and the speech organs are also similar transducers.

According to Leton, the ability to receive coded representations of orthography and the ability to produce language output are prerequisites to reading which are also characteristic abilities of both the child-learner and of computer input and output devices. There is said to be a great difference, however, between computer memory

and human memory, in terms of reading, since human memory is a two-stage process of immediate recall and long-range memory, while computer memory is described as a single-state reservoir. For these reasons, Leton states that it may be equally easy or equally difficult to teach the child and the computer to read--the essential process of conversion is the same.

With these relationships in mind, the Simuread algorithm for reading has been constructed, wherein, the rules for each sign are developed as they occur within the texts of the readers. This algorithm is said to be deterministic rather than heuristic, since the rules denote the sign designates associations. At last report, the program was said to contain 4,700 Fortran statements, as well as a procedure for computing the frequencies of associations within a passage. It is stated that the errors which appear in computer designations of phonemes are similar to the errors that children make in learning to read. A significant finding in the use of the Simuread program is one in a case where three first grade readers were processed with the result that the ratio of /d/ designates to /b/ designates was 44:1, whereas, in American English the relative frequency of /d/ to /b/ phonemes is about 3.0:1.6.

The analysis that Simuread and other such programs are

capable of providing can be quite useful in the development of reading materials--we can evaluate for conformity to known gradients in the acquisition of reading skills and we can also discover new patterns. It is implied, by Leton, that the capacity of such programs can enable us to control the frequency of certain phonic associations in reading materials for the benefit of bi-lingual or language handicapped children. An overall advantage is that computer simulation is said to provide for a more detailed study of the acquisition of reading skills than achievable in laboratory or classroom studies. In addition, computer research in reading can also provide insights into types of learners and allow for correlations of abilities and successes through the use of data banks.

Preparation (Pre-Service) of Reading Teachers Through Computers

Computer simulations have been taken a step further than application to the learning to read process--it has also been used to teach teachers how to teach reading. Computer simulations of educational situations provide valid practice for prospective teachers in areas such as teaching reading in the content areas, reading diagnosis, facilitation of mainstreaming, or information retrieval for lesson planning. Blachowitz and Fairweather (1978) have reported on one such program, funded by the National

Right-to-Read effort in 1975, which was conducted at Northwestern University.

Purpose/Objectives

The instructional management component of the system was designed with the intention of accomplishing the following purposes:

- student registration for the course of study
- storage of diagnostic information
- sequencing of computer-assisted tutorials for each student according to stored diagnostic information
- provision of student performance information to instructors
- provision of communication between instructors, students and programming staff and
- routing students through the diagnostic, instructional, information-retrieval, and communication components of the system

Preparation

The program was piloted with undergraduate and Master of Arts in Teaching students. The information collected at the time of registration, and input, was used to reserve each individual a space in the student's records block for the storage of performance information and to initiate communication between the student and the instructors using the computer. Following registration, each student

underwent an assessment of his/her competency in reading instruction, through information collected on-line, which was converted into a set of prescriptions stated in a specific sequence. The system contained an "electronic blackboard" on which students and instructors could "write" messages to one another. The system was comprised of a set of MULTITUTOR programs which were necessary to allow students with no computer experience to use the options of the system without communicating in computer language.

Interaction Between User and Program

The lesson system consists of simulations on topics such as word attack (ATTACK), emphases in beginning reading (CODE), diagnoses of reading difficulties (DIAG), the use of cloze procedure for assessment and instruction (CLOZE), as well as others. For example, in lesson DIAG the students were required to indicate their choice of tests to be administered to a hypothetical child. Following each choice, the computer provided hypothetical response data as answers to the particular test questions. These were to be scored and evaluated by the pre-service student, in exchange for a computer response which provided a subsequent battery of tests from which to choose.

Lesson Generalization

The simulation format of computer-user interaction seems highly capable of producing appropriate response generalization, since the interaction which does take place is so similar to a real life situation. In this instance, the students received feedback on the entire diagnostic process as it progressed, just as they would in an actual testing situation.

Flexibility of Curriculum

The initial assessment of pre-service students provided a base from which the system could then accommodate each student's individual needs. Performance information was also stored within the system for review by course instructors who could then plan to conduct personal conferences, group lectures, or student evaluations accordingly. Another advantage was that students could flexibly schedule their interaction with the computer.

Scope of Program (Resources Available)

In accordance with the function of an educational data-base such as ERIC, which was considered inconvenient, expensive and impractical for the prescriptive purposes of teacher education and for the students instructional needs, an information-retrieval component was designed as an accessory to the preservice program. The cost for its use averaged approximately $1.00 per student contact hour and

the number of descriptors maintained was kept below eighty to provide for more effective searches.

Adaptability to Various Users

The link between the instructional component and the retrieval component is said to be of particular advantage to the program since it enabled students to be exposed to other informational resources without depending on their initiative or their ability to pin-point their instructional problem. If a student gave a poor performance on any lesson, the retrieval system could be automatically triggered to conduct a search for relevant materials.

User Attitude Evaluation

Blanchowitz and Fairweather report that aside from the participants who found any involvement with computers anxiety producing, 76% felt that the lessons were beneficial. 62% indicated that they were able to use the structures and techniques directly in their practicum experience. Since the project pilot was conducted, the simulations have been used in other pre-service preparations, in preparing tutors for an adult reading academy, and for Right-to-Read in-service training.

Computer Assisted Instruction

CAI can be categorized into four different types: drill and practice, simulation, tutorial, and problem solving programs. Drill and practice programs, the most

common type, provide presentations of a flash card format, to which the user sometimes responds by choosing and indicating an appropriate response from two or more that are offered by the computer in exchange for an indication that the answer chosen is correct or incorrect. Simulation provides the type of interaction previously mentioned in the discussion of Pre-service programs. Simulations also facilitate summarization of learning in a particular area. Tutorial programs, also referred to as "learner-based", are somewhat a combination of drill and practice plus simulation, providing the user with some control over the flow and direction of information while indirectly testing the user's perception of the concept and adjusting the presentation to maximize comprehension. Problem solving programs, also referred to as learner-controlled, teach about the computer in a way that allows the user to learn how to manipulate the entire range of the computer's functions, including the language that is used by the computer. Blanchard (1980) reports that a number of researchers are currently investigating "learner-based" CAI, since it holds the greatest potential for application in classroom reading.

There are many public school CAI reading programs, the largest of which exists in the Chicago Public Schools. It is stated, by Blanchard, that over 12,000 students

receive daily instruction from commercial drill and practice programs on 850 terminals. This reading instruction covers grades two through six and emphasizes decoding, literal and figurative comprehension, plus some study skills. The delivery of satellite CAI in reading will soon be available in Alaska.

Preparation of the Student

Obertino (1974) reports that lesson writers and curriculum builders of the PLATO systems express concern that their programs provide a "way in" for their users. They indicated that a child that had to acculturate himself to a set way of doing things in order to begin interacting with their lessons might not readily accept their materials. For this reason, they set out to write lessons which would accept the child's behavior and shape that behavior in positive directions, however non-conventional.

In a CAI literacy development program for adults, using Lite I: Initial Reading and Job Orientation (on the IBM 1500), Golub (1974) explains that: when the student sits down at the computer, he is given instruction in 1) how to use the CAI equipment at the station 2) location of the alphabet keys, and 3) input of biographical data. For all new users of CAI, some form of introduction should be included which will optimally facilitate access to the programs.

User Personalities

In terms of user personalities, Obertino (1974) discovered the concern of PLATO project contributors over the question of what types of child behavior their programs should be equipped to handle. Four basic categories of user personalities were observed in a kindergarten class of 25 children of which 25% were black and a few were from low SES backgrounds. The categories are as follows:

1) the active non-conventional child who does not follow directions given over an audio device; reacts to objects on the plasma panel as objects to be manipulated rather than sources of information, but will examine his behavior to see how an effect is produced (recalling it over and over) as a misbehaving exploration of the computer's responsiveness--once he discovers an effect that interests him
2) the active conventional child who accepts the social conventions of interacting with the terminal, attends to and follows directions given over the audio device, asks questions or makes reasonable guesses about what is appropriate instead of giving up or engaging in aggressive behavior and appears to be relaxed and to enjoy the variety of responses possible within conventions

3) the passive conventional child who is shy only to the extent that he seems to be over-dependent on the instructions given by the audio device, and will not touch the terminal unless directly instructed to do so

4) the passive non-conventional child who refrains from exploring the terminal at all, will begin to respond appropriately if given encouragement from a human helper, but seems overwhelmed by the novelty of the activity (pp. 11-12)

Types of Input/Output Devices

The heart of the computer is the central processor which acts as the coordinator for the entire system, but between the central processor and the user there are several pieces of hardware which include input/output devices. Blanchard (1980) reports that the most common to reading instruction are the cathode ray tube, which is similar to a television screen, and the teleprinter, which is similar to a teletype machine or typewriter keyboard. The cathode ray tube can display printed text, graphs, charts, photographs, drawings, or slides. It can also be paired with an audio component which permits simultaneous audio and visual instruction--which is essential to beginning reading instruction.

There are several other types of input/output devices,

with a variety of capabilities, some of which are as follows:

- light stenographic headphones (which present audio output from a PLATO IV terminal)
- plasma panels (presenting visual output from PLATO IV; writing speed of 180 characters per second, 60 lines per second; 2,048 character screen capacity; 256 immediately available characters--128 standard type/128 author designable; inherent memory in display panel; response time of .2 second to student input
- slide selector (accompanying PLATO IV plasma panel); back projector through plasma panel allowing superimposed slide images and graphics; capacity of 256 colored slides in micro-fiche format--random addressable by computer; mean access time of .2 second
- interchangeable audio discs (accompanying PLATO IV); capacity to store 23 minutes of random access audio messages, varying in length from .36 - 44 seconds; average access time of .5 second
- light pen - pen shaped device (used to feed responses to program when passed over data to be transmitted)

- cassette based files (used to create data tapes for interchangeable use on the Sol-20)
- TRS- 80 Voice Synthesizer (gives micro-computer the ability to speak when given a DATA statement with phonetic spellings); Radio Shack Level II BASIC

Interaction Between User and Program

In a literacy development program for career-oriented youths at the CAI Laboratory, at Pennsylvania State University, Golub (1974) describes the sequence of interaction between the user and programs as one in which: the Lite I program takes the student through a series of phonics lessons; tests the student for achieving criterion in phonics, and determines whether the student may proceed to a reading pool plus new phonics material; and finally, administers a post-test to determine whether the user may proceed to the Lite II series--at which point the user may choose to end his/her instruction program. From this description it is not possible to determine what the specific steps of interchange between user input and computer output involve. There are, however, program descriptions which do give more precise descriptions of interchange. Some of them are as follows:

For example, the PLATO IV is described by Obertino (1974) as having a student terminal with the capacity to transform into an author terminal with a few key presses--

at which point the programming language (TUTOR), based on English grammar and syntax (for use by the non-experienced), can perform authoring on-line. It permits the author (teacher) to compile a program and go through the lesson in student mode. The student and lesson data gathering and management capacities permit the author (teacher) of a lesson to collect significant on-line student response data, through the lesson which can then be used by the program to modify its pattern of response to the student.

To be more specific, the PLATO IV programs build into every lesson, regardless of content or form, sub-routines which accept and keep count of inappropriate and unexpected student responses, and withhold remedial messages and activities until the child has reached his own mean of inappropriate behavior. These programs also contain lessons which include the following interactional formats:

a) activity performed on a cue as a simple arrangement of audio-visual display and student input that is not under the control of the user student and remains consistent for the entire lesson, for example, when the child hears the phoneme /r/, he touches the grapheme "r";

b) self-paced activity performed in set format, for example, identifying and touching each occurrence of a particular word or letter in a passage;

c) self-paced activity in free format as an arrangement of audio-visual display and user input which is under control of the student, for example, free typing, dictating touch sensitive stories, or creating images from a variety of computer generated characters.

In a "Speed Reading Made Easy" program designed for the Commodore PET Computer, Feldman & Rugg (1979) describe user and program interaction as a tachistoscopic practice wherein: the program flashes a phrase into the screen and blanks it out, the user repeats the phrase, and in turn the program either displays the next phrase for a shorter period of time if the previous response was correct or shows the previous phrase if the response was incorrect and then displays the next phrase for a longer period of time.

In a software package for reading comprehension linked to cassette based files for use with the SOL-20 computer, Heuer (1980) explains the adaptability of the software to the user as "being forgiving to incorrect input and self-instructing." He states that these are the features that separate poor software from people-oriented software. For the SOL-20 reading comprehension programs, extensive instructions have been avoided and the bulk of the free memory was devoted to making the programs as user oriented

(or "idiot proof") as possible. When the user attempts to make major changes to the file, the program visually verifies the changes requested and allows the user to change his/her mind, therefore, preventing experienced and inexperienced users from making silly mistakes or deleting important work.

Lesson Generalization

A crucial concern in the design of any lesson plan is whether or not the student will be able to generalize to other situations the skills which (s)he masters within the context of the lesson. In a CAI project, under the auspices of the All Indian Pueblo Council, the development of a pilot reading comprehension program using culturally relevant reading material and a modified cloze procedure on the HP2000F computer was guided by the intention to aid students in developing some of the reading strategies described by psycholinguistic research rather than "pure skills". According to Wells and Bell (1980), the program was coordinated with the following objectives for students:

- the ability to predict what comes next in a sentence or paragraph;
- the ability to internalize distinctive features of letters and words and to expect them to appear in logical places (they do not use distractors that are very close in spelling to the correct word);

- the ability to take an active role in the reading process; and,
- an understanding that the text must make sense.

Flexibility of Curriculum

An important factor in the successful design of a program is the flexibility of the curriculum or the internal sequencing of lessons and activities. In the PLATO IV, for example, Obertino (1974) indicates that an important project aim was to design into the curriculum structure the possibility for use in a wide range of modes so that teachers would be able to use the materials optimally without altering the personal classroom styles. Obertino discusses the flexibility of the program in terms of a "conceptual tree" which is intended to express curriculum goals--one of which is to improve the student's competence with lessons that take the form of self-contained "modules" of instruction of any length or complexity. It is claimed that the advantage of such structuring is that although a child may need certain competencies to succeed in a given module, these competencies can be gained from the internal coherence of each module. Another advantage highlighted by Obertino is that modularity and internal coherence allow the teacher to build "menus" of activities for individual students according to their particular needs without having to use the

curriculum as it was originally structured.

Flexibility may not always be "lesson internalized", but the overall flexibility of the program is important as well. In the All Indian Pueblo Council CAI project which is programmed on the HP2000F, automatic lesson assignment is maintained by the computer. Wells and Bell (1980) report that if a student consistently scores below 70%, the computer presents the student with a lower level lesson. Accordingly, when a student achieves consistently high scores, the computer presents higher level lessons. In the schools that have their own computer facilities they can input reading passages that are relevant to their own population interests and abilities. They can also execute close specifications such as the desired number of words between blanks.

In some programs, such as the SOL-20, complete flexibility is available--at the discretion of the classroom teacher. Heuer (1980) reports that the reading comprehension package for the SOL-20 consists of three BASIC programs. Two of the cassette based files are to be used by the teacher. One, called TEXT, is to be used by the teacher to create, edit, and copy short story files. The other, called QUES, is to be used by the teacher to create, edit, and copy the question and answer file--thereby permitting complete freedom in lesson structure and sequencing.

Content/Capability of Curriculum

There is now an extensive variety of reading curriculum packages available to accommodate the interests, abilities, and needs of users of all ages. The following descriptions will provide a brief sampling of all that computer applications to reading have to offer. (Some program descriptions will be more specific to lesson capabilities, while others will provide topic titles according to program objectives.)

In a CAI Literacy Development program, described by Golub (1974), which was designed for illiterate and semi-literate adults, the program was divided into two phases--Lite I and Lite II. Lite I, entitled Initial Reading and Job Orientation, included initial sound to symbol, linguistic code breaking instruction; reading materials using code breaking skills and brief selections designed to prepare the reader for the career world. Lite II, entitled Career-Oriented Reading in Various Job Areas, involved the user in materials covering job duties and requirements, job training, job advantages and disadvantages, and job benefits and opportunities at Level 1. Level 2 covered technical details, managing a small business, and foreman and job trainer. A Vocational Interest Inventory is also provided.

In the PLATO IV curriculum series, described by

Obertino (1974), there are cartoon characters who speak to kindergarteners and grapheme-sound presentations for first graders. PLATO also offers instruction programs which allow students to generate language experience stories as well as programs that contain popular stories or reading games (Blanchard 1980).

The Dallas, Texas, public schools have conducted a small bilingual reading program using audio-visual presentations to provide instruction in Spanish and English for first graders learning to read English (Blanchard 1980).

At the University of New Hampshire, reading is being taught to handicapped children through CARIS (Computer Animated Reading Instruction). The program teaches vocabulary skills. When the child selects from four nouns on the screen and touches the noun, a caricature of that noun appears along with four action verbs--the noun caricature acts out the action of any verb which is touched (Blanchard 1980).

Optimal Presentation of Concepts

Obertino indicates that the optimal presentation of concepts is a critical concern in the process of program design. She states that the achievement of this goal will minimize frustration for learners and confusion for program routing--which is dependent upon the learners' demonstrated competence. In terms of accurately reflecting the child's

task in PLATO IV audio-visual displays, Obertino states that the following questions are considered:

- Do audio and visual displays running simultaneously interfere with one another, even if mutually relevant?
- Do mutually relevant audio and visual displays running simultaneously support one another, i.e., strengthen the central idea?
- How about mutually relevant audio and visual displays running sequentially? Do they support, interfere with, get disconnected from each other?
- How can we best use our medium to diagnose and remediate over-dependence on one kind of sensory information? (p. 13)

An important overall consideration here is whether or not the presentations are free from distractions.

In the All Indian Pueblo Council CAI Project using culturally relevant materials and the close procedure, Wells and Bell report that current changes in the program are directed at reinforcement/feedback. It is indicated that the program may be revised so that students will have the opportunity to "re-cloze", after reviewing their choices and errors, and be given a second chance to respond correctly on comprehension items.

Advantages/Disadvantages

1. Computer has ability to pre-store program, evaluate a student's response, and provide information regarding the correctness of the response.

2. Students who receive CAI get response from every four seconds to once every thirty seconds, or 600 times during a 40 minute session at a computer terminal.

3. CAI encourages the active response of the student.

4. Authors can individualize instruction according to specific interests and abilities, as well as achievement.

5. The teacher gains more time in which to provide critical one-to-one instruction.

Student Attitude/Evaluation

Regardless of how efficient or effective we may judge a computer program or CAI experience to be by any of the criteria previously mentioned, we can only be sure that it is ultimately successful by the opinions or responses of its users. We can only be confident that a child or adult will learn optimally from a CAI program if (s)he is sufficiently interested in its presentation and capacity. It has been found, continuously, that, with CAI, motivation and enjoyment are increased (Thompson 1980). Student's attitudes toward the CAI mode of instruction have been extremely positive (Golub 1974). Obertino

describes the PLATO experience as one in which children defined as having low attention spans stayed with some activities for as long as 40 minutes at a time.

Computer Managed Instruction

Although the concept of "management" in the classroom has not been largely accepted as a real process by many educators, the goal of individualized instruction has made classroom management techniques a real necessity. Most reading programs which include a wide variety of materials, teacher's aides, and the tasks that teachers and aids face in coordinating diagnosis and individually prescribed remediation (assignments, activities), cannot be effective without a highly orchestrated management system. Hunnes (1978) indicates that this overwhelming need has led to a prevailing trend in the use of the computer for simplifying, streamlining, and improving the dynamics of the reading classroom. Although CAI is sometimes regarded as a deterrent to the human relationship between teacher and child; CMI (Computer Managed Instruction) solves the practical problems involved in diagnosis, prescription, and continuous monitoring and evaluation, so that the teacher has more time to teach. (Management is the most critical problem that a teacher faces in attempting to individualize a classroom, and teach on a one-to-one basis.) Blanchard (1980) describes CMI as computer management of educational

data. He describes its function as: supporting the clerical effort in the school or classroom by efficiently and economically storing, retrieving, and processing data, as well as diagnosing and prescribing.

Preparation of Teachers

In a CMI program called Learning Management Programs used in the Kelloggsville, Michigan, school district, Hunnes has found that both administrators and teachers have expressed appreciation for the communications pattern, wherein information is shared on how the Learning Management Program computer can best be used. Teachers need ongoing orientation and support other than that which is available in program manuals in order to execute the capabilities of CMI effectively. There is little direct evidence in the literature that teachers are given lengthy opportunity to become acclimated to the use of the computer system, but it is hoped that they, nevertheless, gain insights, sensitivity, and positive attitudes about computer manipulation through all of the information that is available on student interaction with computers. It is also reassuring to learn that there are many pre-service and in-service teacher-training computer simulations in existence that will give many computer shy teachers sufficient exposure to the medium. In fact, it is likely that the best way for a prospective teacher to learn about the

use of CAI or CMI is through computerized training.

Lesson Planning

In the English Department of Mineola Junior High School, a computerized system for diagnosing, prescribing, monitoring and evaluating pupil progress in reading has been conducted. The system has not provided instruction. Handler (1975) indicates that the computer's capacity for speed, memory, rapid calculation, and information storage and retrieval are used to aid teachers in keeping track of each student's progress in an individualized instructional reading program. He reports that the computer uses a time-sharing terminal and card reader, which is connected to NYIT by telephone, to correct any one of 5,000 drills, quizzes, and exercises for 650 students within 20 seconds. The system also maintains a record of student errors in any one of 11 skill areas. By using these and other available reports in the system, the teacher can create small groups for instruction based on errors made in a particular skill area.

Positive Learning Environments/Attitudes

According to Hunnes (1978), the ability of our students to manage themselves is an important part of the success of a CMI program. He reports that the Kelloggsville Learning Management Program has indeed developed this ability in its youngsters. It has been observed that

the students "take to the center environment." Eighteen months of observation in the junior high program established the fact that "virtually all the youngsters work willingly in the learning center mode, with discipline a minor problem." (p. 286) When the students were asked if they wished to remain involved with the learning center in their next year, 82% indicated "yes."

Advantages

1. In Kelloggsville, the learning performance level rose in three years from among the lowest ranks in the state of Michigan to one above the state average.
2. The sequential methods and feedback capabilities of a CMI program safeguard the teacher against teaching gaps.
3. CMI systems can be curricularly flexible--such that the authors will fulfill requests to shift emphasis in the diagnostic process and inventory of modules to adapt them to curricular specification.
4. CMI maintains accountability.
5. CMI allows the teacher to take advantage of a student's present achievements and concentrate on his/her areas of greatest need.

6. CMI provides rapid collection of errors and reinforcement of correct responses.
7. Obertino states that the PLATO curriculum management system will accept any curriculum which can be described in terms of activities attached to objectives arranged in order of predecessors and successors.

Teacher Attitude Evaluation

Hunnes reports that teachers who were involved in the Kelloggsville Learning Management Program found that "it is a much more systematic way of finding out what help a child needs and providing it than we formerly had." (p. 283, 1980) Hunnes also attributes the success of the program in the Kelloggsville schools to the fact that the teachers like it.

The Role of the Programmer

The role and function of those who are responsible for creating research and instructional programs is undoubtedly complex in nature, but, for our purposes, we will attempt to explore briefly the critical areas of development that contribute to effective projects in reading and reading instruction. Among several other challenges, Heuer (1980) points out three basic problems which the author of an educational software package must consider:

1) the program must appeal in some way to the student;
2) most educators who must use the programs are rarely familiar with computers and are often quite afraid to use them; and
3) the programmer must try to solve these two problems within the limitations of the computer system to be used. (p. 36)

One of the major criticisms of educational programming is that software developed by educational programmers who are not educators has created difficulties due to lack of awareness of educational techniques (Thompson 1980). The role of the programmer is, to a great extent, molded by the users of the program, their needs, and expectations.

The writers and coordinators of PLATO IV have detailed their conceptualization of a "promising and realistic basis" for the development of effective materials on the premise that: reading can be defined in terms of the following observable and measurable behaviors:

- the acquisition of some behaviors is prerequisite to the acquisition of others;
- some behaviors may be acquired independently of others; and,
- the detailed, explicit statement of these behaviors, their order and interrelations, provide a sound structure for a computer based system of teaching

reading and diagnosing reading difficulties.

(Obertino, 1974, p. 10)

It is also indicated that the PLATO staff believes in self-paced learning, continuous testing and diagnosis which is transparent to the child, and flexibility of the program which will allow teachers to shape programs to their own classroom practices.

Teacher Input

Obertino states that one of the goals of PLATO developers is to take advantage of the strategies that classroom teachers find effective. This can only be accomplished if teachers are consulted regularly, not only about classroom practice, but, more importantly, about their observations and evaluations of student-computer compatibility performance.

Student Input

Student input is perhaps more valuable than teacher input since the subject around which all educational materials must be focused is the child. Obertino reveals another one of PLATO's worthwhile approaches by stating that "on the basis of the children's reactions, we make revisions and present the revised lessons to new groups of children, in a continuing process of adjustment of our curriculum materials to the behavior of children in public school settings" (p. 8).

At the CAI Laboratory at Pennsylvania State University, the coordinators of the literacy development program conducted a summative evaluation to assess the attitudes of the subjects toward the course of study. A formative evaluation was also conducted to assess the significance of pre- and posttest scores. The formative evaluation involved five to ten students who were observed with the following questions in mind:

- How long do students stay on line?
- How many times do students return to the program?
- How many units does the student complete in a gauged time period?
- What topics do students choose most often?
- Are two attempts per item sufficient?
- Are vocabulary, syntax, and readability at prescribed reading level?
- Do reading selections give information that is new for the student?
- Do reading selections have an organization pattern that helps students answer comprehension, vocabulary and language skill items?
- Can the student demonstrate 90% knowledge of vocabulary, 80% knowledge of comprehension, and 70% knowledge of skills? (Golub, 1974, pp. 282-283)

Such measures are, no doubt, useful in determining

effectiveness.

Consultation Available

In the Kelloggsville Learning Management Program Hunnes discusses a feature of the system which is invaluable in terms of the success of a program after the programmer releases his finished software package: ongoing consultation. Some of this is provided by the system's authors in workshops which they conduct for administrators and teachers before and during the school year. A Learning Management Consortium was also provided on a monthly basis and involved a committee of principal/coordinator and one teacher representative from each school using their programs. A program representative attended to monitor the meetings, exchange information, and make suggestions.

Conclusions

The use of computers in reading research and reading instruction is not as wide as we would expect it to be in comparison to their abounding capabilities and existing applications in the field. There may be several reasons for limited implementation. Thompson (1980) says that use is confined by the combination of available programming, type of computer, financial resources, curricula and creativity of the users. She also claims that cost-effectiveness of computer usage is directly related to the computer's instructional application in a specific setting,

rather than on equipment and software costs.

There has been some reluctance, by teachers, to accept the services of instructional programming, but, with the increasing demand for individualized instruction, CAI and CMI can only be regarded as aids to effective teaching. It is doubtful that the computer can actually replace classroom teachers since teachers are needed to monitor, encourage, and provide follow-up reinforcement for student users. Blanchard (1980) contends that "today's reading teacher has not and will not be replaced by the computer. Instead the computer is supporting teachers in their attempts to deliver quality and affordable individualized reading instruction." (p. 433) He predicts that the future of computers in the classroom promises continued growth as costs decline and the quality of the educational program improves.

The future of computer applications in reading and reading instruction is viewed by Thompson as one in which CMI could be an asset in the mandated educational plan for learners--both gifted and handicapped. She indicates that the computer could be used to form models to test cognitive theories in reading and to match teacher techniques to the individual's most effective learning modality. She points to other possible research in areas such as attitudinal changes toward reading through the use of the

computer and the Hawthorne Effect. Obertino predicts that the capacity of the computer to collect, store, process, and display data will, in a few years, provide far more extensive knowledge about the teaching of reading than has been previously available.

We cannot reject the idea of computer application to reading instruction. It is too late. Just as the technology of television is here to stay, so is the technology of the computer. Therefore, we must seek to make constructive evaluations and contributions in relation to its use. We must seek to become familiar with the capacities and capabilities of hardware and software so that we can take advantage of their strengths and avoid their weaknesses. It is hoped that the areas of interest in the body of this text will provide a framework for examination of relevant aspects.

References

Ball, S., and Bogatz, G. A. The First Year of Sesame Street An Evaluation. Princeton, New Jersey: Educational Testing Service, 1970.

Blachowicz, Camille L. Z., and Fairweather, Peter G. "A Computer-Assisted Pre-Service Program in Reading". Reading Horizons, Vol. 19, No. 1, Fall, 1978.

Blanchard, Jay S. "Computer-Assisted Instruction in Today's Reading Classrooms". Journal of Reading, Vol. 23, No. 5, February, 1980.

Bretz, R. Television and Ghetto Education: The Chicago Schools Approach. Selected Rand Abstracts: Cumulative Edition, 1963-1972.

Dunn, B. J. The Effectiveness of Teaching Selected Reading Skills to Children Two Through Four Years of Age by Television. Paper read at the American Educational Research Association Conference, 1970.

Eller, M. L. Individualized Learning Using T.V. Educational Broadcasting, 1975, 8, 27-30, 42.

Golub, Lester S. "A Computer Assisted Literacy Development Program". Journal of Reading, Vol. 17, No. 4, January, 1974.

Handler, Kenneth. "The Computer Comes to the English Classroom: Computerized Monitoring of Pupil Progress in

Reading". Educational Technology, Vol. 15, No. 11, November, 1975.

Heuer, Randy. "Reading Comprehension for The SOL-20". Creative Computing, Vol. 6, No. 4, April, 1980.

Homme, L. A Behavior Technology Exists--Here and Now. Paper read at the Aerospace Education Foundation's "Education for Seventies Seminar," Washington, D.C., 1967.

Hunnes, Frank. "The Kelloggsville Story: Learning Management As A Means to More Effective Teaching of Reading". Phi Delta Kappan, Vol. 60, No. 4, December, 1978.

Leton, Donald A. "Computer Simulation of Reading: A Progress Report". Journal of Reading Behavior, Vol. 6, No. 2, July, 1974.

Martin, J. G., and Meltzer, R. H. Visual Rhythms: Report on a Method for Facilitating the Teaching of Reading. Journal of Reading Behavior, 1976, 8, 153-160.

Mason, George E., and Mize, John M. "Teaching Reading With Television: A Review". Educational Technology, Vol. 18, No. 10, October, 1978.

McDonald, T. F. The Effect of Auditory, Supraliminal, and Written Reinforcement of Words Presented by ITV on the Vocabulary Development of Seventh and Eighth Grade Pupils. In G. B. Shick and M. M. May (Eds.) Reading:

Process and Pedagogy. Nineteenth Yearbook of the National Reading Conference, 1971, 2, 128-133.

Obertino, Priscilla. "The PLATO Reading Project: An Overview". Educational Technology, Vol. 14, No. 2, February, 1974.

Rogers, John F. "The First 'R': Reading Practice with the TRS-80 Voice Synthesizer". Creative Computing, Vol. 6, No. 4, April, 1980.

Rugg, Tom, and Feldman, Phil. "Speed Reading Made Easy... Via Your PET". Creative Computing, Vol. 5, No. 1, January, 1979.

Thompson, Barbara J. "Computers in Reading: A Review of Applications and Implications". Educational Technology, Vol. 20, No. 8, August, 1980.

Wells, Bethany J., and Bell, D. Scott. "A New Approach To Teaching Reading Comprehension: Using Cloze and Computer-Assisted Instruction". Educational Technology, Vol. 20, No. 3, March, 1980.